

Response to the PCT Written Opinion

1) The following opinions were expressed in the Response dated July 6, 2004 issued by the PCT International Searching Authority.

"Although claims 1 to 9 possess novelty, Document 1 describes a high purity hafnium material where the zirconium content is reduced to 2400ppm, and having a purity of 4N excluding gas components. Further, Document 2 describes a technique of separating hafnium and zirconium to realize high purification, and it would be easy for those skilled in the art to apply the foregoing technique to Document 1 in order to further reduce the zirconium content."

Documents 1 and 2 are as follows:

Document 1: US2003/0062261 (JP2002-105552)

Document 2: US5112493 (JP5-33072)

2) Nevertheless, foregoing Documents 1 and 2 are significantly different from the present invention and cannot be used as the basis for easily achieving the present invention. The reason for this is explained in detail below. Incidentally, for the convenience of comparison with the Cited Documents, the claims are once again indicated below.

Claims

1. A high purity hafnium material, and a target and thin film formed from said material, wherein the zirconium content is 1 to 1000wtppm, and the purity thereof is 4N to 6N excluding gas components such as carbon, oxygen and nitrogen.
2. The high purity hafnium material, and the target and thin film formed from said material according to claim 1, wherein oxygen is 500wtppm or less, nitrogen and carbon are respectively 100wtppm or less, iron, chromium and nickel are respectively 10wtppm or less, and the purity thereof is 4N to 6N excluding gas components such as carbon, oxygen and nitrogen.
3. A manufacturing method of high purity hafnium including the steps of making aqueous solution of chloride of hafnium, thereafter removing zirconium therefrom via solvent extraction, performing neutralization treatment to obtain hafnium oxide, further performing chlorination to obtain hafnium chloride, and reducing this to obtain a hafnium sponge.
4. The manufacturing method of high purity hafnium according to claim 3, wherein the moisture content in the hafnium chloride before reduction and in the

atmosphere is 0.1wt% or less, and the nitrogen content therein is 0.1wt% or less.

5. The manufacturing method of high purity hafnium according to claim 3 or claim 4, wherein the reduction atmosphere is argon atmosphere, and reduction is performed under a positive pressure of 1 atmospheric pressure or greater.

6. The manufacturing method of high purity hafnium according to any one of claims 3 to 5, wherein electron beam melting is further performed to the hafnium sponge in order to obtain a hafnium ingot.

7. The manufacturing method of high purity hafnium according to any one of claims 3 to 6, wherein hafnium chloride is reduced with metal having stronger chloridization power than hafnium.

8. The manufacturing method of high purity hafnium according to any one of claims 3 to 7, wherein the zirconium content is 1 to 1000wtppm, and the purity thereof is 4N to 6N excluding gas components such as carbon, oxygen and nitrogen.

9. The manufacturing method of high purity hafnium according to claim 8, wherein oxygen is 100wtppm or less, nitrogen and carbon are respectively 30wtppm or less, iron, chromium and nickel are respectively 5wtppm or less, and the purity thereof is 4N to 6N excluding gas components such as carbon, oxygen and nitrogen.

3) Next, the present invention is compared with the Cited Documents.

Foremost, the invention of "a high purity hafnium material, and a target and thin film formed from said material" claimed in claim 1 and claim 2 is compared with the Cited Document 1. With respect to Document 1, as the Examiner has already acknowledged, large quantities of zirconium are contained in the hafnium, and it is evident that the zirconium content in the Document 1 is not at the extremely reduced level where the zirconium content is 1 to 1000wtppm as claimed in the present invention.

Thus, the Examiner is presenting Document 2 and stating that it could be combined with Document 1 to further reduce the zirconium content.

Nevertheless, Document 2 relates to technology of separating zirconium from hafnium with a single-operation chromatography process, but there is no specific numerical value to be the target of zirconium content in the hafnium. The only presumption that can be made is that the content will be a level of nuclear

reactor quality.

Generally, a hafnium material to be used in a nuclear reactor contains 2 to 3% of zirconium. Even those that have been particularly reduced exceed 0.1%, and we believe there is no Cited Document that has significantly reduced the zirconium content in the hafnium to 1 to 1000wtppm.

Therefore, it would be clearly erroneous to say that the invention of claim 1 and claim 2 could have been easily devised based on such Document 1 and Document 2.

4) Next, regarding the invention pertaining to a "manufacturing method of high purity hafnium" claimed in claims 3 to 9, Cited Document 1 describes a method of cleansing a zirconium sponge or a hafnium sponge with hydrofluoric nitric acid and thereafter performing electron beam melting, and Document 2 describes high purification via the chromatography method. These are clearly different from the manufacturing method of high purity hafnium of the present invention, and are not similar in any way.

Therefore, the invention of claim 3 to claim 9 could not have been easily devised based on Document 1 and Document 2. And, the manufacturing method invention of claim 3 to claim 9 yields a superior effect of being able to obtain hafnium with a significantly reduced zirconium content of 1 to 1000wtppm.

5) Accordingly, the invention of this PCT application is not something that could have been easily achieved based on the technology described in Cited Documents 1 and 2, and clearly possesses novelty and inventive step in comparison to the conventional technology.